CS4410 Homework 1

=== *Questions* ===

Generated for *cs4410*

Friday, February 12, 6pm ET

Question	#Points	Percentage
1. Tell us about yourself	8	14.3%
2. Computer Arithmetic	24	42.9%
3. Architecture	16	28.6%
4. Harmony	8	14.3%
Total	56	100.0%

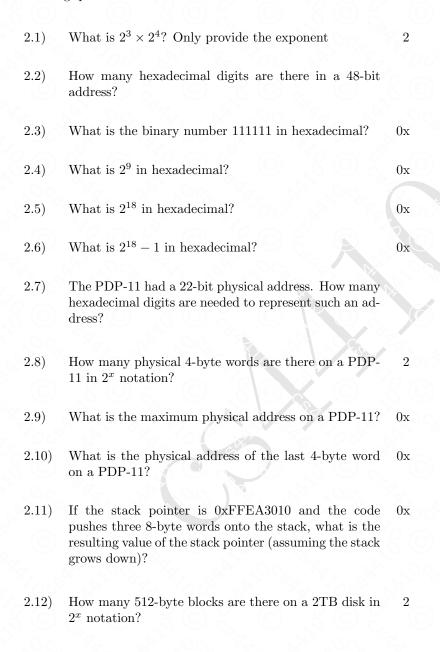# Question 1: [8 points] Tell us about yourself

1.1)   What is your NetID?

1.2)   What is the time difference with Cornell (e.g., -3 if in San Francisco, 0 in Ithaca, 5 if in London, 12 if in China)?

1.3)   Would you like to opt out from study groups?

1.4)   (Optional) What are your preferred pronouns?

(Optional) We would like to get to know you better. Tell us a few more things about yourself below:

Question 2: [24 points] Computer Arithmetic

Read **https://www.cs.cornell.edu/courses/cs4410/2021sp/resources/background.pdf** and answer the following questions:

2.1)   What is $2^3 \times 2^4$? Only provide the exponent   2

2.2)   How many hexadecimal digits are there in a 48-bit address?

2.3)   What is the binary number 111111 in hexadecimal?   0x

2.4)   What is 2^9 in hexadecimal?   0x

2.5)   What is 2^{18} in hexadecimal?   0x

2.6)   What is $2^{18} - 1$ in hexadecimal?   0x

2.7)   The PDP-11 had a 22-bit physical address. How many hexadecimal digits are needed to represent such an address?

2.8)   How many physical 4-byte words are there on a PDP-11 in 2^x notation?   2

2.9)   What is the maximum physical address on a PDP-11?   0x

2.10) What is the physical address of the last 4-byte word on a PDP-11?   0x

2.11) If the stack pointer is 0xFFEA3010 and the code pushes three 8-byte words onto the stack, what is the resulting value of the stack pointer (assuming the stack grows down)?   0x

2.12) How many 512-byte blocks are there on a 2TB disk in 2^x notation?   2

Question 3: [16 points] Architecture

Select one for each of the following questions. You get 4 points for each correct answer, 0 points for each wrong answer, and 1 point for a question left open.

(3.1) In a memory-mapped disk device, a core can read a word from the disk using a load machine instruction just like it can read a word from RAM. Select one:

True
False

(3.2) When a processor executes an instruction, the PC is always increased. Select one:

True
False

(3.3) Divide-by-zero is an example of an asynchronous, maskable signal. Select one:

True
False

(3.4) For efficiency, different cores of the same CPU can share the same registers and their stack. Select one:

True
False

Question 4: [8 points] Harmony

Read **Chapters 1 and 2 of the Harmony book** (available at harmony.cs.cornell.edu). This question is designed just to make sure that you are able to enter and run Harmony programs.

Consider the following Harmony program (which you can download from www.cs.cornell.edu/courses/cs4410/2021sp/resources/pascal.hny):

```
const N = 2

def factorial(n):
    result = 1 if n == 0 else (n * factorial(n - 1))

def C(n, k):
    result = factorial(n) / (factorial(k) * factorial(n - k))

def pascal(x, n, k):
    result = 0
    while x > 0:
        if k == n:
            k, n = 0, n + 1
        else:
            k += 1
        result += C(n, k)
        x -= 1

x = choose({0..N})
assert pascal(x, 0, 0) == x
```

It asserts that $\texttt{pascal}(x, 0, 0) == x$ for all x from 0 to N (inclusive). However, the program only tests for $N \in \{0, 1, 2\}$.

4.1) What is the lowest non-negative integer N for which the assertion fails? Enter 'inf' if you think there is no such N (no proof required).

4.2) Same question, but replace the assertion with $\texttt{pascal}((x * (x + 1))/2, 0, 0) == ((2 * *x) - 1)$